THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

At Weed Heights, in the valley of the winding Walker River in west-central Nevada, The Anaconda Company brought into production the first new copper mine of major proportions in the United States since the end of World War II. The company is mining low-content oxide copper ore at its Yerington pit in Nevada, and sulphur ore at its Leviathan pit in California. The sulphur ore is trucked 58 miles to the FluoSolids plant at Weed Heights, where it is processed into sulphuric acid, which is used in leaching copper from the copper-bearing ore.

When Anaconda's general manager, Albert E. Millar, moved to the town of Yerington, Nevada, in December, 1951, there was nothing on the hillsides west of town but sagebrush and the scratches left by earlier exploration activities. No equipment or materials were available at the site. The nearest rail connection was 12 miles away.

The first shovel entered the pit area and began digging in June, 1952. The first cement copper left the property in November, 1953. In less than two years, a mine and plant with an annual production of 60,000,000 lb. of copper were in operation, and offices, shops, warehouses, and more than 250 homes and community facilities were planned and built. It is hard to believe that such an enormously complex job was carried out successfully in so short a time.

The orebody at Yerington mine is a porphyry copper. After the overburden is stripped, the ore is mined in benches 25 ft. high. This height of bench minimizes the danger of slides resulting from undercutting by the power shovels, and provides greater opportunity for selective mining. Each primary blast consists of three rows of holes loaded with Hercules Tritex*, or equivalent. Results from blasting are uniformly satisfactory.

The orebody at the Leviathan sulphur mine in California, approximately 100 ft. thick, was buried under 300 ft. of overburden. Anaconda contracted this tremendous stripping job to Isbell Construction Company of Reno, Nevada. Isbell started operations in the latter part of 1952. From then until December, 1954, the contractor moved 22,000,000 tons of waste. Some of this waste was highly siliceous, requiring considerable drilling and blasting to break it for economical shovel loading.

After stripping, the sulphur ore is mined from 15-ft. benches. An average primary blast comprises five or six rows of holes loaded with Hercomite.® A minimum of secondary blasting is required. After crushing, the ore is hauled the 58 miles to the processing plant at Weed Heights.

For a complete description of this amazing development, please turn to page 167.

*Hercules Powder Co. Trademark.

* * *

Howard L. King of New York City and Harvey Slocum of Alhambra, California, have been named as the 1956 recipients of the awards given annually by The Moles for outstanding contributions to the construction industry. The awards will be made at the annual dinner-ceremony in the Waldorf-Astoria Hotel in New York on February 2, 1956.

Further details are presented in the article on page 183.

* * *

When the Ohio Turnpike was opened to the public on October 1 of this year, it marked two firsts in superhighway construction in the United States: the longest stretch of superhighway ever completed at one time — 241 miles; and the first major postwar turnpike ever finished on schedule and with money to spare.

Please turn to page 184.

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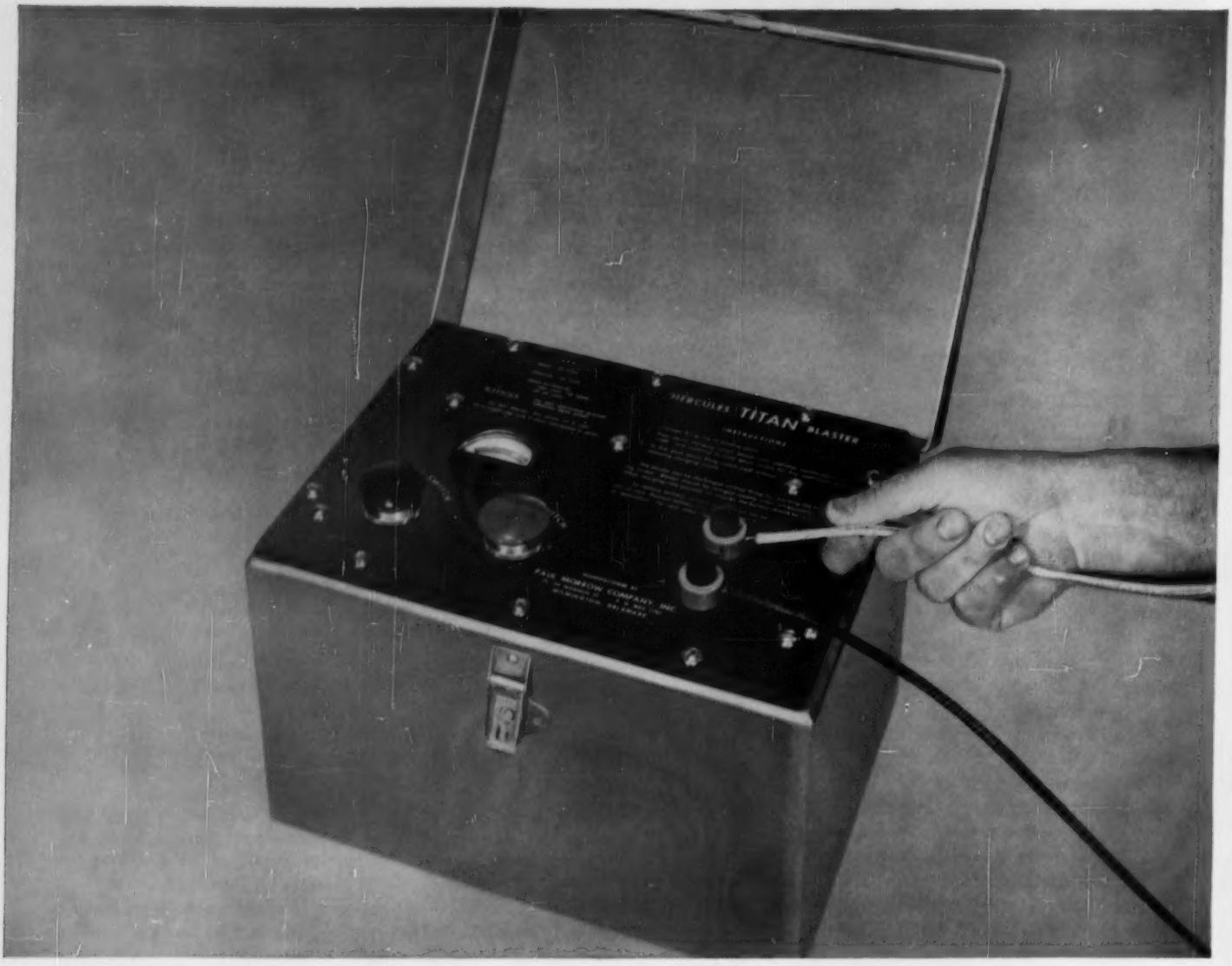

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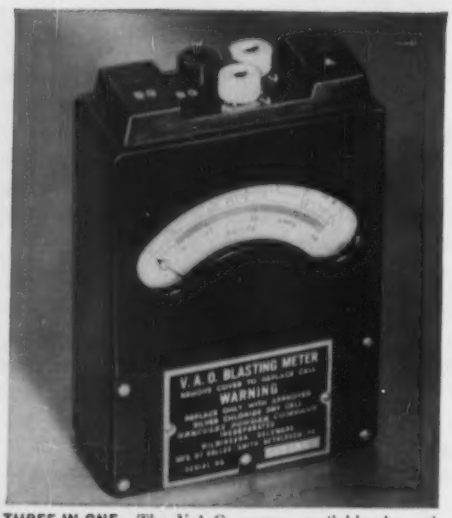

THREE-IN-ONE—The V.A.O. meter, available through Hercules, is a combination voltmeter, ammeter, and blasting galvanometer that has proved its value in field use as an important blasting aid.

The Hercules Titan Blaster is a high-capacity, condenser discharge type of blaster that combines maximum safety with minimum maintenance expense.

The Titan Blaster has no moving parts. It is operated by depressing two push-button switches—one to charge and one to fire. This new Hercules blaster develops sufficient electrical energy to fire as many as 1,200 detonators. Yet, there is no high voltage associated with the Titan Blaster except during charge and firing. The source of energy is a relatively inexpensive 6 volt, dry cell ignition-type battery.

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WORTHINGTON

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Albert E. Millar

GENERAL MANAGER

YERINGTON MINE AND PLANT

THE ANACONDA COMPANY

A Biography

BEGINNING in December of 1951 with a set of plans, a staff of four, and boundless enthusiasm and energy, Albert E. Millar, general manager of The Anaconda Company's Yerington mine and plant at Weed Heights, Lyon County, Nevada, in less than two years, transformed a sagebrush-covered Nevada hillside into an impressive modern industrial facility that maintains an annual production schedule of 60 million pounds of copper. At the same time, he directed the development of Anaconda's sulphur ore mine in Alpine County, California, and supervised the planning and construction of 250 houses, eight dormitories, and recreational facilities for Weed Heights employes.

In the mining industry, the name of Albert E. Millar has become a synonym for enormous accomplishment.

Bert, as he is known to his friends and associates, was born in Cambuslang, Scotland, November 22, 1898, the son of William J. and Isabella MacAuslin Millar. His parents emigrated from Scotland to Canada when he was a boy. He completed his elementary education in the grade school in Winnipeg, Canada, and the Winnipeg Collegiate Institute. After graduating from the Institute, he worked for two years as a substation operator and timekeeper with Arizona Copper Company before joining the Army Air Corps (Canadian Air Force).

Following his discharge from the Air Corps, Bert matriculated at Texas College of Mines and Metallurgy in El Paso and was graduated as a mining engineer with the class of 1922. His extracurricular activities included the presidency of the Scientific Club, now a part of the American Institute of Mining and Metallurgical Engineers; editor of *The Prospector*, the college paper; member of the debating and dramatic clubs; and a participant in interschool wrestling, boxing, and tennis matches. He followed up his college career by completing the La Salle Extension University correspondence courses in commercial Spanish, higher accountancy, and C.P.A. coaching.

Following graduation from college, Bert went to work for Moctezuma Copper Company at Pilares de Nacozari in Mexico, as safety and efficiency engineer. In 1924, he left Mexico to accept a position as junior engineer with Chile Exploration Company, an affiliate of The Anaconda Copper Mining Company, at Chuquicamata, Chile. Later, he was promoted to mining engineer in charge of all company operations. Besides his regular engineering duties, his job called for planning all operations on the project and calculating the explosives charges and other details involved in the tremendous amount of blasting that was, and is being, done at this big open-pit mine.

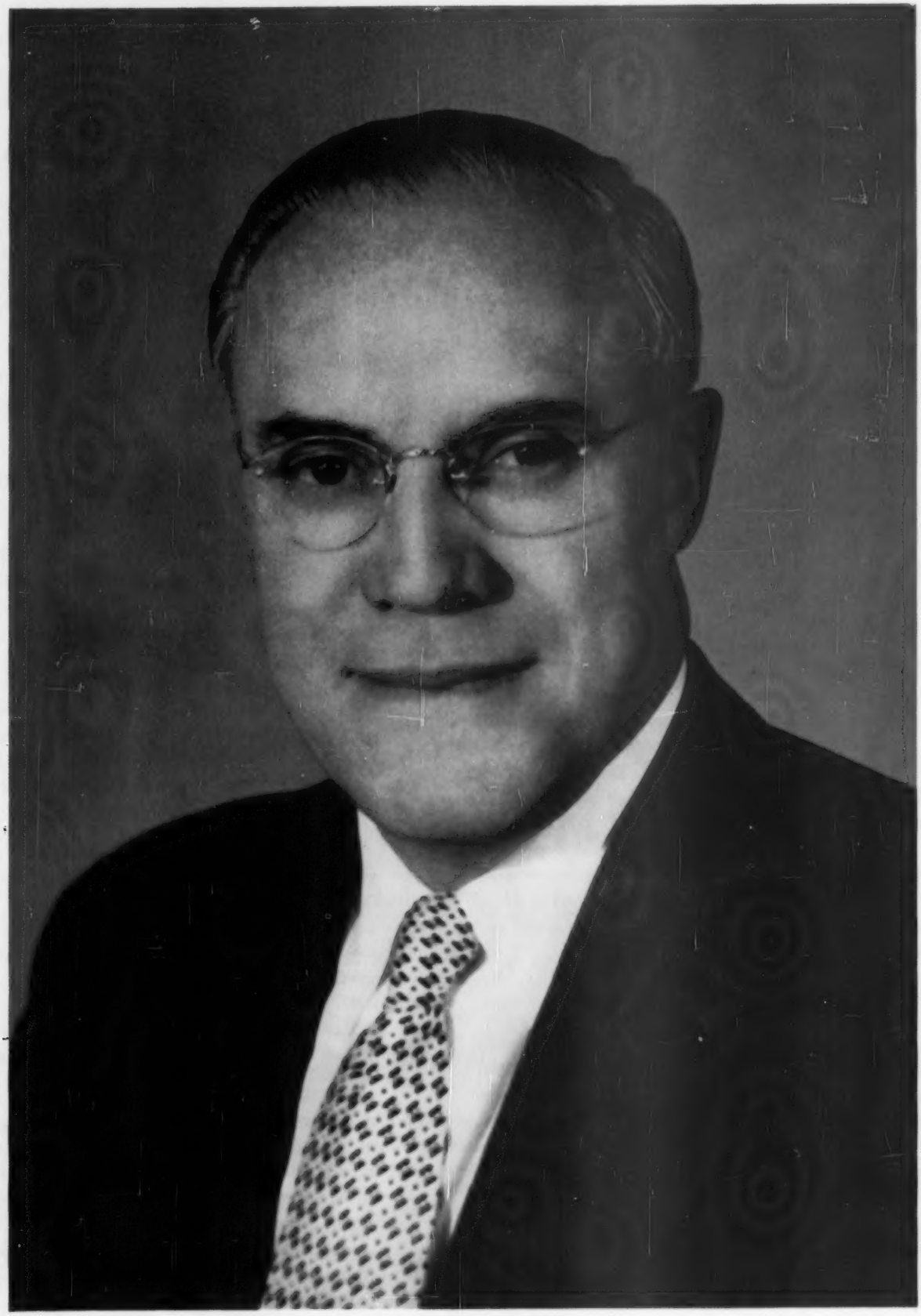
In 1940, Bert returned to the United States to become liaison engineer for Anaconda American Brass and the Canadian Government's Department of Munitions. After two years on this assignment, he was made pit-development superintendent at Cananea Consolidated Copper Company. This was followed by two years, in the same capacity, at Inspiration Consolidated Copper Company.

In 1949, Bert was transferred to the New York office of The Anaconda Copper Mining Company to cover field investigations for Vice President Clyde E. Weed. Two years later, he was made general manager of Anaconda's Yerington mine and plant at Weed Heights, Nevada. His responsibilities include the direction of operations at the company's Leviathan sulphur ore mine in California.

In addition to his business affiliations, Mr. Millar is active in professional and fraternal societies: president of the Nevada Mining Association; member of the Advisory Board of Mackay School of Mines; member of American Institute of Mining and Metallurgical Engineers and American Mining Congress; registered professional engineer, mining and metallurgy, State of Nevada; pioneer member of A.F. & A.M., El Paso Lodge No. 130; Shriner, El Zaribah Temple, Phoenix, Arizona. He has been a teacher in Bible classes for many years.

Albert E. Millar married Virginia Mae Knight on August 8, 1923, in El Paso, Texas. They have one daughter, Virginia Millar Taylor, and three grandchildren. The family home is in Weed Heights, Nevada.

It would seem that this extremely busy, and modest, man would have no time left to indulge his hobbies, but Bert Millar manages time as well as he manages people. He is often found at the bridge table or on the golf course with his friends where he finds relaxation from his diversified responsibilities, many of which are self-imposed and are done for the betterment of his fellow man, for he genuinely likes people.



ALBERT E. MILLAR

Editorial

From All Of Us To All Of You — A Merry Christmas And A Happy New Year

Now Is the Time To Join the Safety Crusade

For more than thirty years, THE EXPLOSIVES ENGINEER has been devoted to the promotion of safety and efficiency in the mining, quarrying, and construction industries. That our effort has been successful is shown by the statistics recorded annually in the National Safety Competition.

While we are grateful to the operators of mines and quarries for the progress made in achieving safe working conditions in the mineral industry, we shall never become complacent. There is still much work to be done.

The National Safety Competition

The National Safety Competition was inaugurated in 1925 by the Bureau of Mines, U. S. Department of the Interior, in cooperation with THE EXPLOSIVES ENGINEER. In that first nation-wide contest, 210 mines and quarries were enrolled, a significant number that demonstrated real interest in, and great need for, an effort of this kind.

Last year, the thirtieth anniversary of the competition, 579 mines and quarries were enrolled, with a total worktime of 126,695,445 man-hours. In the 1925 contest, not one of the contestants operated the full year without a lost-time accident. Last year, 227 of the 579 plants enrolled turned in perfect safety records, an all-time high. The number of participants and, in particular, the 227 perfect safety records are just tribute to the founders of the competition of three decades ago, and to the sincere desire of the mineral industry to eliminate accidents.

Teamwork

The primary responsibility of adequate safety programs lies with management. Fortunately, most progressive companies have experts on their staffs who are directly responsible for safe operations. However, if these safety men are to succeed in their safety programs, they must have the wholehearted support of top management personnel. Also, it is a function of management to supply proper equipment, materials, mechanical safeguards, and working conditions for the job. Aggressive management has come to realize safe operations are synonymous with profitable operations.

Once an efficient safety program has been approved and put into operation by management, it is the responsibility of every employe to cooperate to the fullest. Injury-free records are made through coordinated, determined effort on the part of every man on the job — from top to bottom. Teamwork must prevail, if accidents are to be eliminated.

Eligibility

To be eligible for the Sentinels of Safety trophy, a mineral operation must have underground workings or quarry or open-pit workings which are actively operated for at least 100 days, and the total of such work underground or inside the quarry or pit must be 30,000 or more man-hours during each contest year.

Basis of Awards

The participating operations are divided into six groups or classifications: anthracite underground mines, bituminous-coal underground mines, metal underground mines, nonmetallic underground mines, open-pit mines, and quarries.

The five mines and the one quarry that have the lowest injury-severity rates (number of days lost through disabling injuries per 1,000 man-hours of worktime) are the winners in their respective groups. A disabling injury is one that incapacitates an employe for longer than the remainder of the day on which the accident occurred.

The Sentinels of Safety Trophy

The winning company in each of the six groups is awarded a bronze Sentinels of Safety trophy, donated by THE EXPLOSIVES ENGINEER. Each employe of these six companies receives an individual Certificate of Achievement in Safety signed by the director of the United States Bureau of Mines.

THE EXPLOSIVES ENGINEER also presents a green-and-white Sentinels of Safety flag to each of the six winners.

Join the Safety Crusade

Enrollment in the National Safety Competition offers an opportunity to join a nation-wide crusade for safety in the mineral industry. Rules of the contest and application forms may be obtained from the Accident Analysis Branch, Bureau of Mines, U. S. Department of the Interior, Washington 25, D. C. The competition begins each year on January 1 and ends on December 31.

Write to the Bureau today.

WEED HEIGHTS, NEVADA: This view from an airplane of Anaconda's new development at Weed Heights, Nevada, shows the Yerington open-pit copper mine at left; plant structures at right; and employe homes and community facilities in the background. In less than two years, a sage-brush-covered hillside was converted into a project that realized, and has maintained, a production schedule of 60,000,000 lb. of copper annually.

MINING WITH ANACONDA IN NEVADA

In less than two years, The Anaconda Company developed open-pit mines and plant facilities that realized a production schedule of 60,000,000 lb. of copper annually

LEWIS NORDYKE*

THE first new copper mine of major proportions to be brought into production in the United States since the end of World War II is in historic mining country – the valley of the winding Walker River in west-central Nevada. It is The Anaconda Company's Yerington mine-mill operation at the newly established town of Weed Heights, an astutely engineered project in which the venerable but energetically progressive company is mining low-content oxide copper ore from one pit and sulphur ore from another. The sulphur ore, mined at the Leviathan open pit near Markleeville in Alpine County, California, is trucked 58 miles to the FluoSolids plant in the vicinity of the copper mine at Weed Heights, Nevada. The sulphur ore is processed into sulphuric acid, which is used in leaching copper from the copper-bearing ore. The copper precipitate, or cement copper as it is commonly called, is shipped 800 miles by rail to the com-

*2809 Lipscomb Street
Amarillo, Texas

pany's smelter at Anaconda, Montana.

In principle, this method of recovery is as old as the hills; so is open-pit mining. But this operation is far from run-of-the-mill. Rather, it is remarkable in many respects, not only for mining engineers, but for the men and women who use copper tubing, wiring, and such intricate things as the innards of television sets. Big industry is doing a whopping job for peaceful living and for arming to defend peaceful living in case of attack. There is no better example of atomic-age pioneering than Anaconda's Nevada operation.

Amazing Developments

Starting on a sagebrush-covered hillside, The Anaconda Company developed open-pit mines and plant facilities in an amazingly short time; this despite the fact that at its sulphur mine in California there was an earth-moving job almost equal to that of the volcanoes and glaciers that shaped this craggy-browed country eons ago. The company has put a brand-new town — Weed Heights — on the mining camp-marked map of Nevada; it has solved some king-sized puzzlers of fire (in the sulphur ore), underground water (in the copper pit), nervous earth, haulage, and weather. The project offers an excellent example of how government and industry can cooperate in the production of essential material.

Probably the most significant factor at this operation is how effective engineering, blasting, and processing can profitably recover low-content ores. The ore in the pit averages from 0.80 to 0.90 per cent copper. Old tunnel stiffs who hopefully roamed the valleys of the Walker during the past century couldn't earn beans in ore like this; it takes mass production, massive machinery, and master engineering to get the job done.

No telling how many prospectors have searched for their burros in this region. The Walker River, which rises to the west in the Sierra Nevadas, is fed by snow in the lofty reaches of the mountains and flows first through

MINE DEVELOPMENT: Churn drills are kept busy putting down blast holes to provide economical excavation of overburden material and to open benches for mining the ore. The benches are 25 ft. high to provide greater opportunity for selective mining.

LOADING ORE: After a blast in one of the benches, a P&H electric shovel with a 5-cu. yd. dipper loads broken ore into Dart rear-end dump trucks, each with a 25-ton pay load. The haulage road distance from the bottom of the pit to the primary crusher is about one mile.

the Smith Valley. Then it cuts a yawning gash in the Singatse Hills in Wilson Canyon to form a scenic wonder known as the Bulkhead. From there it winds through Mason Valley, close to Yerington, and eventually into Walker Lake some 25 miles to the south and east of Anaconda's new plant.

Stockmen and farmers were the first to set up permanent habitation in these broad, fertile valleys. The first ones settled there nearly 100 years ago, and their kind is still there, raising cattle, sheep, hogs, and poultry, and growing alfalfa, wheat, barley, oats, potatoes, onions, and hay. It isn't unusual to see a Grade A dairy farm. No other valleys in Nevada – a state made up of bleak hills and green valleys plus a mighty lot of glittering neon in places like Las Vegas and Reno – have a more highly developed and diversified agriculture.

Copper Is the Big Thing

But copper is the big thing and has been, off and on, for a long time. The red stuff was found in the Yerington region at least 100 years ago. In the 1860's, when the Comstock Lode Canyons at Virginia City and Silver City were throbbing, a good deal of bluestone copper ores from the Yerington hills was wagoned 70 miles northwest to Virginia City. This early copper led to the founding of Yerington, now a tree-lined town with a population around 1,500 and the seat of Lyon County. The Yerington mine and its town of Weed Heights are 80 miles south of Reno. The terrain is fairly rough, with an elevation of 4,500 ft. The rainfall is light, averaging around 5 in. annually. There is comparatively little snow.

The first little boomlet at Yerington years ago soon died and the Smith and Mason Valleys turned again to farming and were as pastoral as a herd of freshly shorn sheep on a green hillside.

Copper came back early in this century, the activity reaching a peak during World War I years. The Nevada Copper Belt Railroad came rolling into Yerington. The stacks of the Big Thompson Smelter billowed penny-colored plumes into the blue. Several mines were in feverish production, and Yerington was the main copper center of the state. At the end of World War I, some copper was being used on such things as coil vibrator points on Model T Fords, but the auto age had not commenced its mawlike appetite for metal. Copper mining around Yerington died a slow death. The railroad was salvaged. The valleys fell back again on farming and ranching.

As everyone knows, copper came back quickly. The automobile and other mechanical advances increased the demand. So did aviation and electronics, and again war.

Intensive Exploration Begins

In 1941, The Anaconda Company took a lease on the claims close to Yerington. The following year, the company started exploration, with plans to get into quick operation. However, sulphur and other materials were in short supply and the idea for wartime production was abandoned. But the deposit looked good, and Clyde E. Weed, Anaconda's vice president in charge of all operations (for whom Weed Heights was named), ordered thorough exploration. Churn drills were put to work to drill holes on 200-ft. centers. There was also a good deal of diamond drilling. A 400-ft. shaft was sunk and laterals were driven on two levels.

Three years of exploration revealed a deposit of around 40,000,000 tons of oxide ore, with a 15,000,000-ton body of sulphide ore below it. A tentative outline for a pit was made. The ore was there, but it was spotty; some outcropped to the surface and some had an overburden of 300 ft. of gravel. There were barren spots as well as pockets of rich ore of up to 6 per cent copper; however, the rich pockets were few. Also, a heavy flow of water underground had to be handled.

When fighting broke out in Korea, the Government called for stepped-up copper production. Anaconda was again ready. Although development would cost around $34,000,000, the company wanted no Government money. A Certificate of Necessity was granted Anaconda by the Government, which permitted the company to amortize, for tax purposes, 75 per cent of the eligible part of the cash outlay for development, this amortizing to come within five years. Moreover, the Government agreed to buy up to 256,000,000 lb. for at least 25½ cents a pound in the first six years of operation, provided Anaconda couldn't sell this copper to industry at that minimum price. Up to the latter part of 1955, the price of copper had not dropped to the minimum price; in-

SECONDARY CRUSHING: This picture includes a part of the secondary crushing system at Weed Heights -- the junction house at left, and one of the copper ore bins at right. After the ore has left the secondary crusher, it is tumbled to obtain proper mixing.

dustry was taking all the copper it could get, and is still crying for more.

The Start of Production

The decision to start the Yerington mine was made in November, 1951. The first shovel bit into a blasted bank in June, 1952, and the first cement copper was hauled away in November, 1953. In the short span of two years, Anaconda brought its copper pit into production; it developed its sulphur source; it built offices, shops, and warehouses. Crushers for the copper ore were installed. The acid plant, leaching tanks, and iron launders were planned and constructed. A village of homes and quarters for single men was laid out and built. The valley came alive. Not far from where the town was being constructed and the administration building and plant facilities were going up came the sound of drilling, blasting, and the drone of shovels and trucks.

At the pit, the initial task was to strip enough waste to expose the ore so that benches could be opened for the recovery of a suitable grade of ore for plant operation. The plant was scheduled to open 15 months after stripping started. Stripping began in the center of the pit area and on the west side in order to make as rapid advance as possible in opening up lower benches and in uncovering ore. The extreme east end of the pit has the heaviest gravel overburden; in certain places, it is about 250 ft. in depth.

The mine is on an alluvial slope adjacent to low hills near the Walker River, with the slope rise at 5 per cent. The orebody, although spotty, is a porphyry copper. Granodiorite, the basement rock, is intruded by quartz monzonite porphyry. Ore occurs mainly in the quartz monzonite, but there is some in the basement rock. The principal copper mineral is chrysocolla.

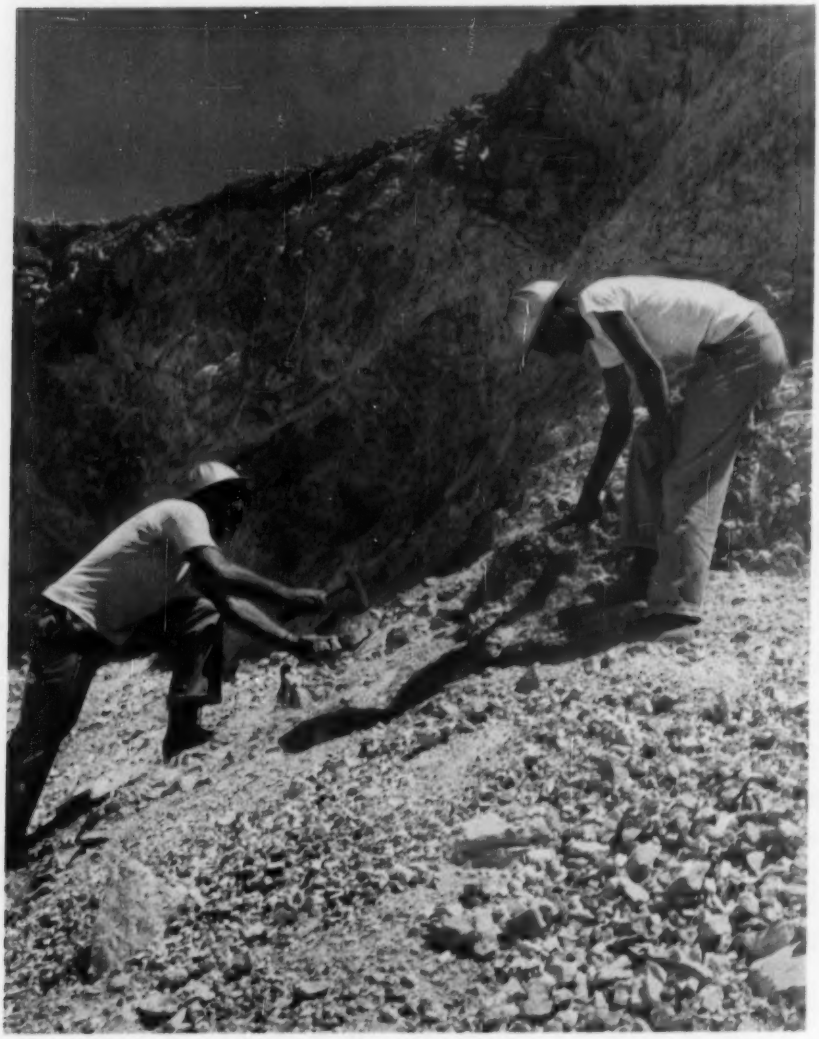
During the stripping operations, some ore was uncovered. After separation from the waste, it was stockpiled.

Selective Mining

The first benches opened in the pit area were 50 ft. in height, calling for blast holes about 55 ft. deep. These relatively high benches proved unworkable because of the danger of slides resulting from undercutting by the power shovels. So, the height of the benches was reduced to 25 ft. The lower height benches also provide greater opportunity for selective mining, that is, the separation of ore from waste and the separation of ore of various copper content. The cut-off point has been 0.6 per cent copper, but ore of lower grade has been placed in separate dumps with the idea that the cut-off point may be lowered, and possibly, at a later date, be reloaded or heap-leached from these dumps.

There is constant probing with prospect holes ahead of the blast areas. Cuttings from the drilling of all blast holes are assayed. In this way the engineers keep close tab on the grade of ore in every part of the pit. When a bench is blasted and the shovel noses in, the engineers know in advance the grade of ore coming from that place and can keep a fixed grade of ore — approximately 0.85 per cent copper — going to the plant.

From the beginning of mining activities, water was both a blessing and a problem. The average mining camp in the West is faced with the puzzle of how to obtain water for plant use and for other operations, but in this case there was plenty of water. The underground flow was reckoned at 1,500 g.p.m. The pit area to the southeast was rimmed with wells which were put on pump. The water supplies the



EXAMINING WASTE: Two geologists are at work examining the waste material from the pit. A close watch of the content of the ore and waste is maintained as the present cut-off point of 0.6 per cent copper may be lowered. Prospecting continues without pause.

LEVIATHAN MINE: This view of the Leviathan mine at Markleeville, Alpine County, California, shows some of Isbell Construction Company's equipment stripping overburden on the upper benches while Anaconda's operators mine sulphur ore on the bottom bench.

mine, plant, and the town of Weed Heights, and this pumping also lowers the water level inside the pit limits well in advance of the mining. The static water level has been lowered more than 100 ft., and no water appears on the present lowest bench in the pit. The program consists of wells strategically located just outside the pit area, drilled to a depth of about 100 ft. below the bottom of the ore in the pit. With them, the engineers have complete control of the water level.

The material in the pit varies in hardness; some is earthy and relatively soft and some is very hard. Occasionally a bushel-sized boulder rolls out.

Drilling and Blasting

Blast holes approximately 8 in. in diameter are drilled with a Joy 58BH Champion rotary unit, with Hughes 7⅞-in. bits. The drill is truck-mounted and electrically powered. Transformers are mounted on it to furnish electric current at the proper voltage to operate two compressors with a total capacity of 732 c.f.m. at 100-lb. pressure. The drill averages around 280 ft. per shift.

The pattern for drilling blast holes is determined by the type of material encountered on the benches. On the average 25-ft. bench, the holes are 30 ft. deep, spaced on 20 to 24-ft. centers. Each blast involves three rows of holes, with the rows 20 ft. apart. The first row is 25 ft. from the solid toe of the lower bench.

Each drill hole is loaded with Hercules Tritex,* or equivalent, on a ratio of 1 lb. of explosives to 7.8 tons of material in place, and one 6-in. by 25-lb.

*Hercules Powder Company Trademark

cartridge of Gelamite® 1. The charges are primed with Primacord.** One electric blasting cap is attached to the two ends of the Primacord along the first row of holes, and No. 9 MS connectors are used between the second and third rows of holes. Blasts are fired with Hercules 50-cap blasting machines. The results from the primary blasts are uniformly satisfactory and very little secondary blasting is required. Three portable compressors furnish the compressed air needs in the mine: a Chicago Pneumatic with 600 c.f.m., a Chicago Pneumatic with 315 c.f.m., and an Ingersoll-Rand Gyro-Flo with 315 c.f.m.

Recovering Blasted Material

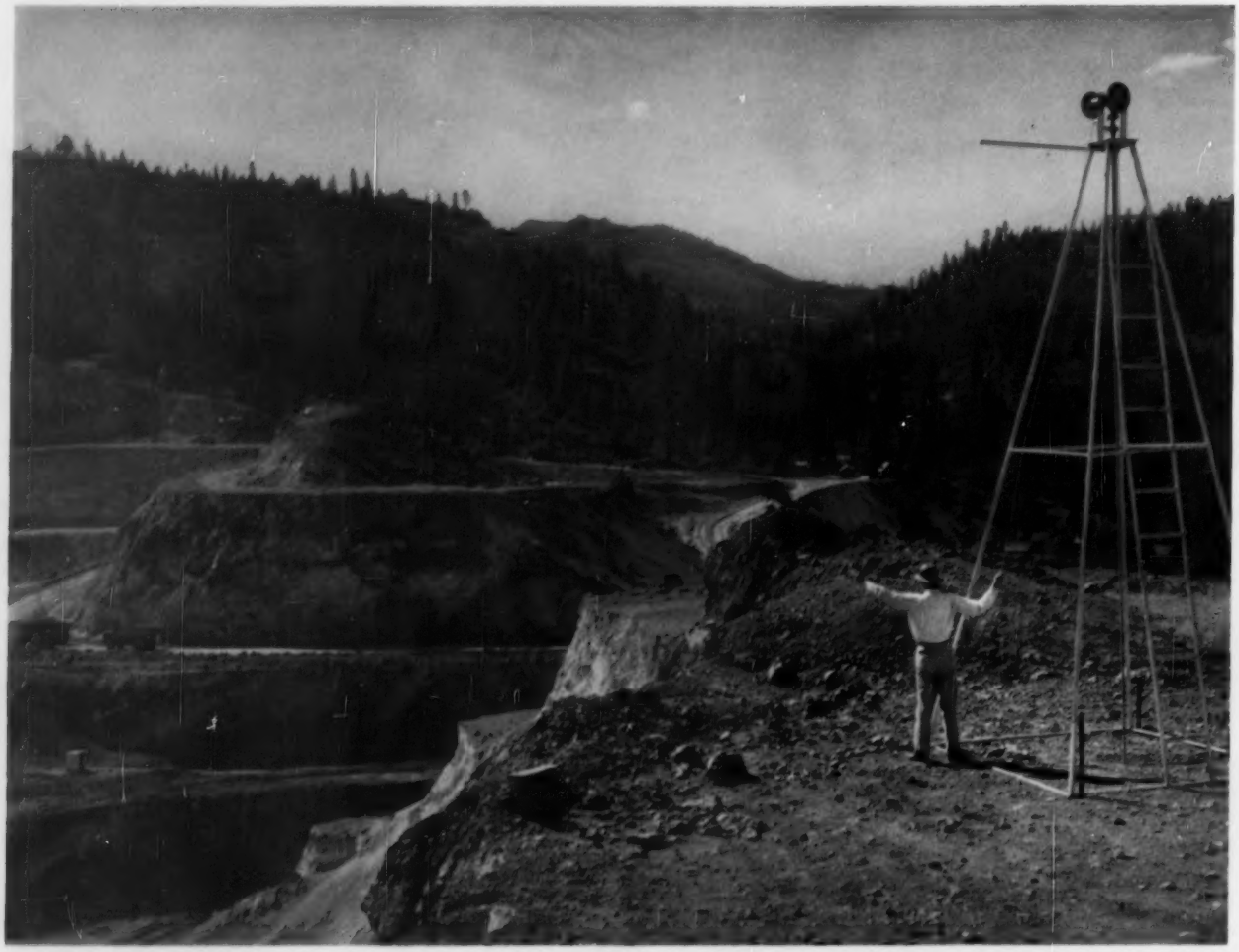
After a blast has been fired, P&H 1500 electric shovels with 5-cu. yd. dippers nose into the broken material. The shovels load into Dart rear-end dump trucks equipped with twin-disc torque converters, 300-hp. Cummins diesel engines. From six to nine trucks, each with a 25-ton pay load, are required to keep one shovel operator busy, with the number of trucks depending on the length of haul. The haulage road distance from the bottom of the pit to the primary crusher is about a mile. It has a maximum grade of 8 per cent. Sprinkler trucks and road patrols keep the roads in excellent condition.

The principal equipment in the mine includes four shovels and 30 haulage trucks; six D8 Caterpillar tractors with dozer blades; one Super C turnadozer; one Caterpillar 80 scraper; one Caterpillar Model 12 auto patrol; one Caterpillar Model 112 auto patrol; two Bucyrus-Erie 42T churn drills, electrically powered (used mainly for water well and prospect hole drilling); two Chicago Pneumatic wagon drills; three ¼-ton pickups; two 2-ton utility trucks; two diesel-powered water trucks; one lubricating truck equipped with power greasing; one truck with A-frame and winch; one tractor-trailer fuel truck; one P&H 225A truck crane; and miscellaneous units.

Loaded trucks from the mine dump over a 6-in. grizzly into a 54-in. Traylor gyratory crusher set at 4 to 5 in., equipped with a Ducon dust-collecting

**Reg. U.S. Pat. Off. by The Ensign-Bickford Company

DRILLING AT LEVIATHAN: In preparing holes for blasting at the Leviathan mine, this Joy rotary drill, with one operator and a helper, averages 30 ft. of hole depth per hour.



BLASTING SIGNAL: Before firing a primary blast in the Leviathan sulphur mine, a warning signal is given by sounding an air horn. Ample time is provided for everyone in the area to take cover. A carefully planned safety program for all operations is rigidly enforced.

system. Power for the crusher is from a 400-hp. Westinghouse motor.

The secondary crushing system includes a Symons 7-ft. standard cone crusher (with one stand-by) and three Symons 7-ft. shorthead cone crushers (with one spare), along with conveyors, screens, bins, etc.

The crushed ore, which has been reduced to minus ¾ in., is placed on a main feed belt as it leaves the secondary crushers. Water sprays, with carefully controlled quantities of water, are used at several places on this feed belt in order to accomplish what Weed Heights personnel calls agglomeration. This agglomeration, which prevents segregation of the very fine material in the crushed ore, has been developed and is applied at Weed Heights with great success, thus avoiding the otherwise necessary heavy expenditure for a desliming plant. As stated, this agglomeration is achieved by wetting each layer of crushed ore as it falls onto the main feed belt. After the feed has left the secondary crusher building, it is tumbled in order to obtain proper mixing. This tumbling is achieved by placing an S in the conveyor belt; it is further achieved at the sampling tower. The material is then transferred to a 1,300-ft. conveyor belt that carries it to the loading bridge for distribution into the leaching tanks. The ore, as placed in these leaching tanks, is then subjected to a sulphuric acid leach which extracts the copper from the ore, placing it in solution as a copper sulphate.

After leaching, the copper solution is carried to storage tanks and from there to the cementation launders. At the cementation launders, by flowing the copper solution over light-gauge iron, the copper is precipitated out of the solution and iron is placed in solution. The copper precipitate is then carried to trommels for washing and the washed copper precipitates are then partially dried and ready for shipment. The methods used at Weed Heights for copper precipitation are very efficient, as one may realize when considering the fact that over 5 million pounds of copper are produced each month with very high efficiencies.

The copper precipitates are hauled 12 miles from Weed Heights to the rail head of the Southern Pacific Company at Wabuska, Nevada, from where shipment is made by rail to the smelter at Anaconda, Montana. Hauling of the precipitates to Wabuska and the hauling of light-gauge scrap iron from the rail head to Weed Heights are accomplished by truck. These trucks are especially built for this purpose and were designed locally and manu-

factured by Fruehauf. The truck had to be of a type which would allow the maximum permissible highway load for two types of material; namely, copper precipitates which weigh about 175 lb. per cu. ft., and light-gauge processed scrap iron which weighs about 20 lb. per cu. ft.

The Leviathan Sulphur Mine

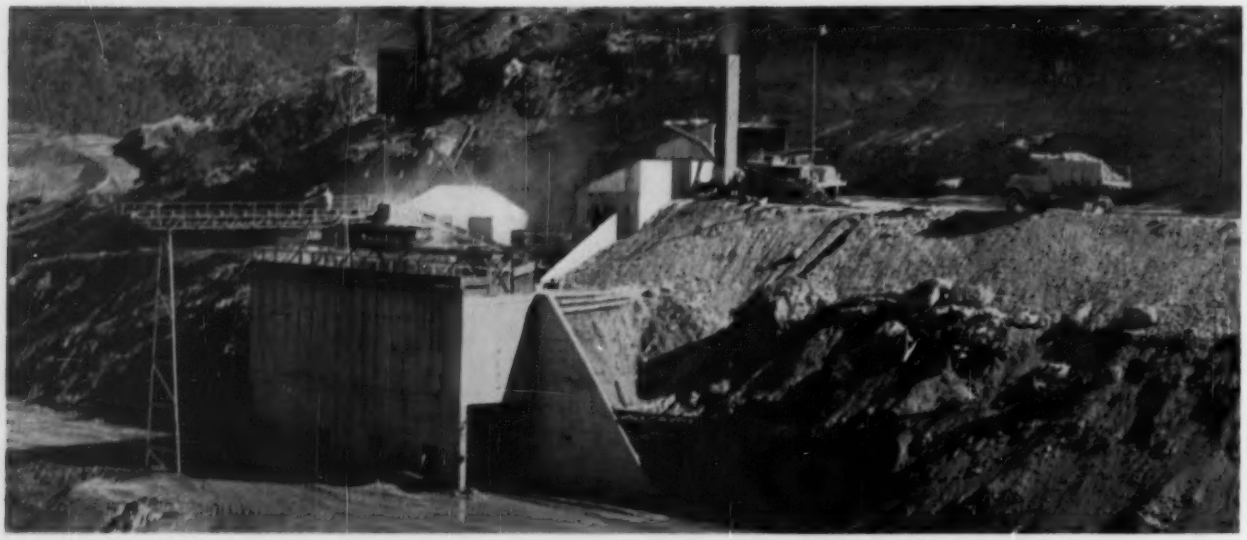
When Anaconda decided to go ahead with the mining of oxide ore at Yerington, the management was faced with the problem of supplying its own acid, since sulphur was in short supply at that time. Fifty-eight miles away in the edge of the Sierras in Alpine County, California, was the Leviathan mine, which belonged to Texas Gulf Sulphur Company. Anaconda bought the property in 1951.

The orebody at the Leviathan mine, approximately 100 ft. thick, runs about 28 per cent elemental sulphur. Leviathan had been only partially explored by underground work and diamond drilling before Anaconda bought it. Additional prospect drilling by Anaconda outlined this sulphur ore deposit.

At first, Anaconda considered underground mining, since the sulphur deposit, in the throat of an ancient volcano, was buried under 300 ft. of overburden. But the danger of fire in such a mine was great. Open-pit operation promised to be more economical, despite the high stripping ratio of waste to ore.

Anaconda contracted this tremendous stripping operation to Isbell Construction Company of Reno, Nevada. The first major task facing the Isbell

AFTER A. BLAST: A Bucyrus-Erie 120B power shovel with a 6-cu. yd. dipper loads out blasted overburden covering the sulphur ore. Isbell Construction Company uses two of these big shovels on stripping operations at the Leviathan mine.



CRUSHER AND BINS: Trucks, in background, are delivering sulphur ore from the Leviathan pit to the crusher. After crushing, the ore is discharged into bins from where Wells Cargo trucks are loaded for the 58-mile haul to the processing plant at Weed Heights.

company was to get equipment on location in this section. The mine, at an elevation of 7,200 ft., is 18 miles south and slightly east of Gardnerville, Nevada, and 35 miles south of Carson City, the state's charming capital city. The country is rough, but beautiful with the greenery of pine, fir, and other timber. It is wild, too, with deer, a few black bears, bobcats, and mountain lions. An access road of 12 miles had to be built from U. S. Highway 395 through this virtually virgin region to reach the Leviathan area.

Stripping Vast Plateaus of Waste Material

It took about five months to build the road, haul in the equipment, and establish a camp and shop facilities. Isbell started stripping activities in the latter part of 1952. From then until December of 1954, the contractor moved 22,000,000 tons of waste. Vast plateaus of this waste material surround the mining area. Most of the waste was fairly soft and easily handled, but some was highly siliceous, requiring considerable drilling and blasting to break it for economical shovel loading.

In stripping the Leviathan mine, Isbell used the bench system. Equipment included six Bucyrus-Erie 29T churn drills; two Bucyrus-Erie 120B electric shovels; two Northwest 80 diesel shovels; twenty Euclid Model T rear-dump trucks; and four Caterpillar D8 bulldozers.

Any way you look at it, the Isbell organization did a whale of a job of stripping for Anaconda.

Unlike the Yerington mine, Levia-

PROCESSING SULPHUR ORE: At Yerington, sulphur ore becomes sulphuric acid after being worked through four plant units: the crusher, at left; the rod mills; the FluoSolids plant; and the acid plant. Each day, 600 tons of ore are used in manufacturing sulphuric acid.

LEACHING VAT: A closeup of one of the leaching vats at the Weed Heights plant, where dilute sulphuric acid is used to recover copper from the oxide ore. The overhead mobile bridge is equipped with a clamshell bucket for unloading the contents of the vat.

than doesn't have clean benches, because of the slide problem at the edges of the ore-production area. The volcanic earth is nervous and quaky; it isn't unusual for earth movement to break water pipes. The Wells Cargo Trucking Company has been given a contract to haul the sulphur ore from Leviathan to Weed Heights. Because of the weather, the mine is operated only six months of the year. At 1,600 tons of ore production daily (one 10-hr. shift) Leviathan produces enough sulphur for 12 months' operation at Weed Heights.

Mining the Sulphur Ore

Mining of the sulphur ore is on 15-ft. benches. Like the copper ore at the Yerington mine, it is spotty, some places being almost devoid of milling material. Because of this, highly selective mining – much like that at Yerington – has been developed. The separation of the ore from waste in the mine is a major operation.

At Leviathan, the principal blasting problem is to break the sulphur ore so that it will feed into a Cedar Rapids 25 by 40 jaw crusher just outside the mine. This primary crushing operation is necessary to reduce the ore for truck haulage to Weed Heights.

Holes for blasting are drilled with a truck-mounted Joy 225 rotary drill, basically like the Joy 58BH at Weed Heights. The drill rod is 2⅜ standard (PK). Hughes Tri-cone "hardrock" bits, 6¾ in., are used. The rig has a compressor of 350 c.f.m. at 40 p.s.i.

The material in the 15-ft. benches is essentially a mass of boulders. Blast holes are drilled 20 ft. deep, spaced on 10-ft. centers, in rows 9 ft. apart. They are loaded with Hercomite® 2 dynamite packed in 23G containers,

CEMENTATION LAUNDERS: The gantry crane over the 20 parallel cementation launders at Yerington dumps light-gauge scrap iron in the form of cleaned tin cans into the launders with the big magnet and removes precipitates with the clamshell.

PLANT STRUCTURES: This view of the plant at Weed Heights includes the water tower looming up at the left, followed by the rod mill, the secondary crusher, and the primary crusher.

size 5 in. by 24 lb. The explosives loading ratio is 1 lb. of dynamite to 1.9 tons of material in the solid. The charge in each hole is primed with reinforced Primacord. Stemming of the charges is accomplished with cuttings from the drilling operation.

An average primary blast consists of five or six rows of holes. The holes in each row are tied together with plain Primacord. Hercules® Electric Blasting Caps are placed at each end of the first row; No. 9 MS connectors – two at each end of each row – are used. The blast is fired with a Hercules 50-cap blasting machine. There is relatively little secondary blasting.

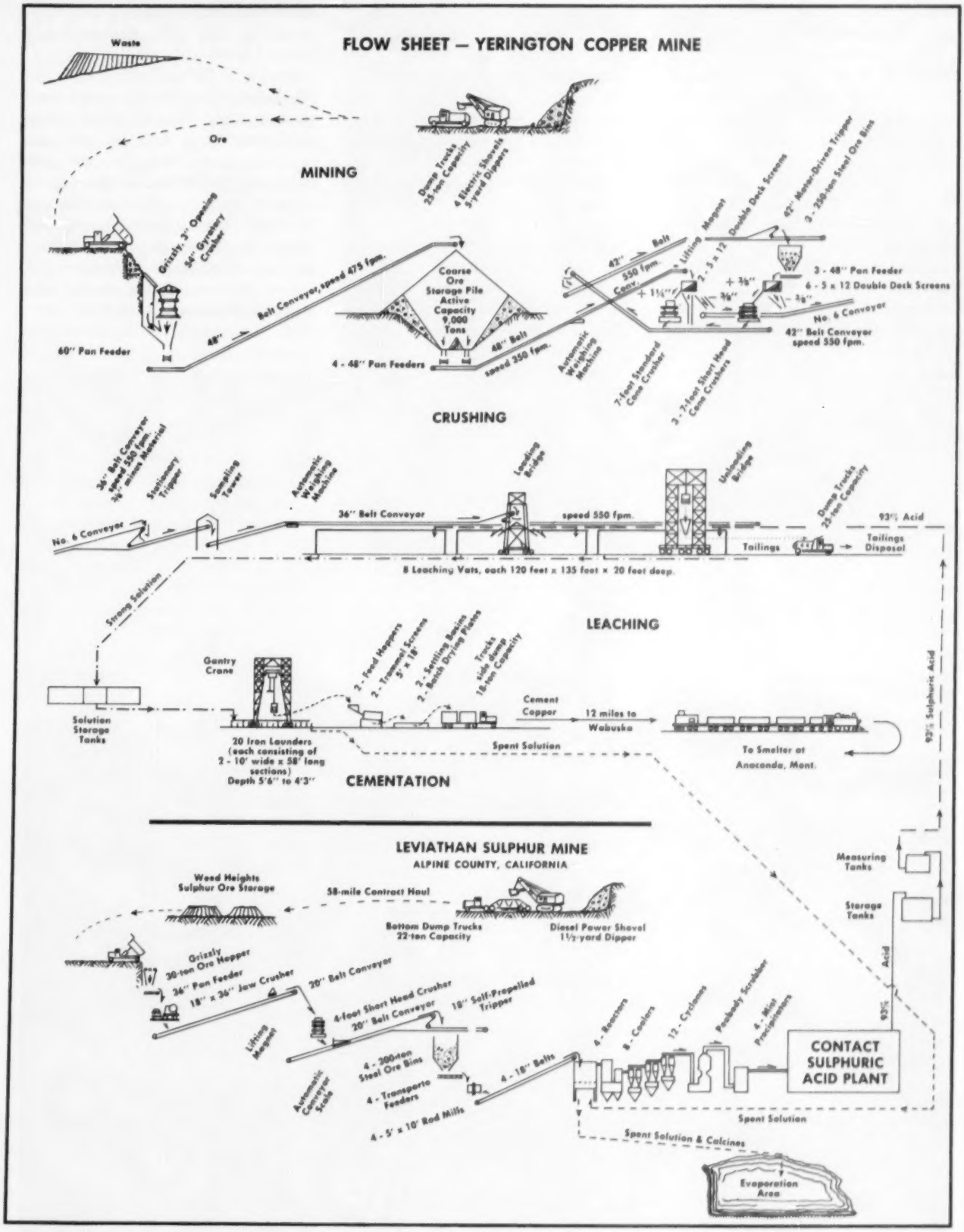
A Joymobile wagon drill, equipped with a compressor producing 315 c.f.m. at 90 to 110 p.s.i., is used occasionally for drilling hard toes; it uses 1¾-in. Liddicoat throw-away bits.

Blasted ore is excavated with P&H 655B shovels with 1½-cu. yd. dippers, and loaded into Dart Model 110 trucks with 200-hp. Cummins diesel engines. Each truck hauls 11 to 12 tons to the primary crusher just outside the pit; they dump onto an apron feeder over a grizzly. The crushed ore is conveyed to a four-compartment bin from which Wells Cargo Trucking Company trucks, the contract hauler, load through air-activated gates.

Two power shovels and four mine haulage trucks are used in the mine at Leviathan. Other equipment includes a D8 Caterpillar with U dozer; a 20-ton stockpile truck designed and built by the garage foreman; a GMC water truck with pump for fire fighting; and miscellaneous trucks for mine service. The company generates its own electrical power with Caterpillar generators: a D13000, a D8800, and two D311's. One of the D311's is a portable and is used as a stand-by. Equipment at the mine and primary crusher is maintained at Leviathan; major repairs are handled at Weed Heights.

Hauling Sulphur Ore To Weed Heights

The Wells Cargo Company of Reno maintains the access road from U. S. 395 to the Leviathan mine and hauls the sulphur ore the 58 miles to the plant at Weed Heights. The company uses a fleet of Peterbuilt and Mack


FLOW SHEET — YERINGTON COPPER MINE
Waste
Ore
MINING
Dump Trucks 25-ton Capacity
4 Electric Shovels 5-yard Dippers
Grizzly, 3" Opening
54" Gyratory Crusher
60" Pan Feeder
48" Belt Conveyor, speed 475 fpm.
Coarse Ore Storage Pile Active Capacity 9,000 Tons
4 - 48" Pan Feeders
48" Belt speed 350 fpm.
Automatic Weighing Machine
7-foot Standard Cone Crusher
3 - 7-foot Short Head Cone Crushers
42" Belt Conv. 550 fpm.
Lifting Magnet
Double Deck Screens
42" Motor-Driven Tripper
3 - 250-ton Steel Ore Bins
3 - 48" Pan Feeder
6 - 5 x 12 Double Deck Screens
No. 6 Conveyor
42" Belt Conveyor speed 550 fpm.
CRUSHING
36" Belt Conveyor speed 550 fpm. 36" minus Material
Stationary Tripper
Sampling Tower
Automatic Weighing Machine
Loading Bridge
Unloading Bridge
Dump Trucks 25-ton Capacity
No. 6 Conveyor
36" Belt Conveyor
speed 550 fpm.
93% Acid
Tailings
Tailings Disposal
8 Leaching Vats, each 120 feet x 135 feet x 20 feet deep.
Strong Solution
LEACHING
Gantry Crane
2 - Feed Hoppers
2 - Trommel Screens 5' x 18'
2 - Settling Basins
2 - Batch Drying Plates
Trucks side dump 18-ton Capacity
Cement Copper
12 miles to Wabuska
To Smelter at Anaconda, Mont.
93% Sulphuric Acid
Solution Storage Tanks
20 Iron Launders (each consisting of 2 - 10' wide x 58' long sections) Depth 5'6" to 4'3"
Spent Solution
CEMENTATION
LEVIATHAN SULPHUR MINE
ALPINE COUNTY, CALIFORNIA
Measuring Tanks
Storage Tanks
Acid
93%
Wood Heights Sulphur Ore Storage
58-mile Contract Haul
Bottom Dump Trucks 22-ton Capacity
Diesel Power Shovel 1½-yard Dipper
Grizzly
30-ton Ore Hopper
36" Pan Feeder
18" x 36" Jaw Crusher
20" Belt Conveyor
4-foot Short Head Crusher
20" Belt Conveyor
18" Self-Propelled Tripper
Lifting Magnet
4 - 200-ton Steel Ore Bins
4 - Transporta Feeders
4 - 5' x 10' Rod Mills
Automatic Conveyor Scale
4 - 18" Belts
4 - Reactors
8 - Coolers
12 - Cyclones
Peabody Scrubber
4 - Mist Precipitators
CONTACT SULPHURIC ACID PLANT
Spent Solution
Spent Solution & Calcines
Evaporation Area

cabs of the highway type, diesel-powered, dual-drive tractors with 300-hp. Cummins engines. The ore is carried in bottom-dump semitrailers of 22-ton capacity. Each of the 15 trucks makes five daily trips in delivering the 1,600 tons of ore required at Weed Heights.

Fire has been a hazard and a problem at the Leviathan mine. Fires have been started by blasting, by friction, and by spontaneous cumbustion when high pyrites have been involved. Fires have blazed up in the ore on the benches and in the stockpiles. Occasionally, a truck loaded with ore catches fire. None of the fires caused serious damage, but a close watch must be maintained.

The Wells Cargo trucks, upon arrival at Weed Heights, dump onto a pan feeder, which discharges onto an inclined 30-in. conveyor belt that carries the ore to the jaw crusher. All excess ore over the daily sulphur requirements is stockpiled in the crushing yard.

About 600 tons of sulphur ore are used daily for the manufacturing of sulphuric acid. The sulphur ore as delivered from Leviathan is crushed by means of a 4-ft. Symons shorthead jaw crusher, and then grinding is accomplished in rod mills, the ore being reduced to minus 10 mesh.

Feed from the rod mills goes to the FluoSolids plant. In this plant there are four units, three of which are in use constantly in order to burn the required amount of sulphur ore, and the fourth unit is held on stand-by as a spare. By burning the sulphur ore in reactors, the sulphur is liberated and sulphur dioxide gas is produced. This gas is scrubbed, cooled, and dried, and is then delivered to the contact acid plant for the manufacture of sulphuric acid. The acid plant is capable of pro-

AT THE RAIL HEAD: The copper precipitates are hauled in especially built trucks from the Weed Heights plant the 12 miles to the rail head of the Southern Pacific Company at Wabuska, Nevada, for shipment to the smelter at Anaconda, Montana.

ducing up to 450 tons of sulphuric acid per day.

Operating Personnel

From the beginning of activities all operations have been, and still are, under the direction of A. E. (Bert) Millar. The highly efficient operation at Yerington reflects his wide experience and enthusiastic drive. A graduate mining engineer of the Texas College of Mines and Metallurgy (now Texas Western) at El Paso, he has been with Anaconda since 1924.

Mr. Millar's associates at Weed Heights include H. R. Burch, mine superintendent; C. J. Houck, general mine foreman; A. J. Gould, metallurgical superintendent; F. M. Monninger, general plant foreman; Howard Jacky, foreman of the FluoSolids and acid plants; F. S. Stewart, chief chemist; Don Gill, chief office engineer; M. H. Bissett, chief electrician; Ralph Bentley, master mechanic; Ken W. Humphreys, personnel supervisor; R. K. Owen, storekeeper; and W. M. Cross, garage foreman in charge of all automotive and shovel repairs.

At the Leviathan mine, Frank A. Keith, Jr., is foreman and Roy K. Dondero is engineer and assistant foreman.

Nevada's Newest Town

With the start of operations in Nevada, Anaconda established the town of Weed Heights. It has its own post office, modern swimming pool, tennis courts, nine-hole golf course, recreation center, and softball diamond. There are 250 company-built homes, all rented to company employes. The homes range in size from one-bedroom units to three-bedroom units. Rental to the employes is at a very low rate — $20 to $30 a month, depending on the size. Water is furnished free of charge and electricity at cost. All of the homes are furnished with kitchen utilities. Dormitories for single men are also available.

The personnel turnover at Weed Heights is very low as living conditions are pleasant, employment is steady, and a good type of employe is attracted to this vicinity. The residents can enjoy fishing and hunting in nearby areas, and excellent highways lead to larger community centers such as Reno, Nevada, and San Francisco, California.

H. R. BURCH: Anaconda's superintendent of mining operations at both the Yerington and Leviathan mines.

A. J. GOULD: The metallurgical superintendent at Yerington has had wide experience in copper leaching.

M. H. BISSETT: The chief electrician at the Yerington mine.

F. A. KEITH, JR.: The mine foreman at the Leviathan mine.

NEVADA'S NEWEST TOWN: Anaconda's Weed Heights community has 250 homes for employes, a post office, recreation center, swimming pool, softball diamond, golf course, and tennis courts. The homes have beautiful lawns with flowers, shrubs, and trees.

LEVIATHAN'S TRAILER VILLAGE: At Anaconda's Leviathan mine, the village includes eight 30-ft. and four 35-ft. kit trailers, as well as houses for the supervisory personnel. The community is provided with electricity, a water supply, and a sewage-disposal system.

Howard L. King

Harvey Slocum

THE MOLES AWARDS FOR 1956

Howard L. King and Harvey Slocum to be honored at the annual dinner-ceremony of the association for outstanding contributions to construction progress

AT THE annual dinner-ceremony of The Moles, a New York association of tunnel builders and heavy-construction men, on February 2, 1956, in the Waldorf-Astoria Hotel in New York City, formal presentation of the coveted bronze plaques and citations representing The Moles Awards for 1956 will be made to Howard L. King, a native New Yorker and a member of The Moles, and to Harvey Slocum, the nonmember recipient, of Alhambra, California.

The Moles Awards are made annually to one member and one nonmember of the association. The awards for 1956 constitute the sixteenth time that men prominent in the construction industry have been so honored. In announcing the names of the two most recent winners, E. F. Moran, chairman of the awards committee, said that the awards are given for "outstanding achievement and are considered the highest recognition that can be accorded to individuals for service to the American construction industry."

Howard L. King

Howard L. King, the member recipient, is vice president and chief engineer of Mason & Hanger Company, New York City, one of three firms now building the underwater sections of the third tube of New York's Lincoln Tunnel. The award to Mr. King pays tribute to the part he has played in driving many of the principal underwater tubes serving metropolitan New York, including the Holland Tunnel.

In his capacity as chief engineer for Mason & Hanger, a post he has held since 1935, Mr. King has been prominently identified with the building of the Fulton Street Tunnel, Rutgers Street Tunnel, and the Brooklyn Battery Tunnel.

A graduate of The City College of New York and Columbia University, Howard L. King also holds a degree from Massachusetts Institute of Technology, Cambridge, Massachusetts.

Harvey Slocum

Harvey Slocum, the nonmember recipient, is recognized as one of the world's outstanding builders of concrete dams. His name does not appear in the records of any institution of higher learning, for he terminated his formal education at the eighth grade.

Mr. Slocum began his remarkable career in the construction industry in 1910 as a laborer. Literally working his way from the ground up, he became, successively, a skilled construction craftsman and job superintendent. In 1917, he became identified with the building of dams. Since that time, his name has been associated with the construction of many of the world's largest dams as project manager: Grand Coulee, Hetch-Hetchy, Madden Dam on the Panama Canal, Friant Dam, Davis Dam, and Bull Shoals. At present, he is in India directing the diversified activities connected with the building of the huge Bhakra Dam.

THE OHIO TURNPIKE

DEEP, LONG ROCK CUT: The largest through-cut on the project, on Section C-14, was 80 ft. deep, 150 ft. wide at bottom, 300 ft. wide at top, and 3,300 ft. long. Excavation to grade included stripping 350,000 cu. yd. of soil and blasting 1,200,000 cu. yd. of rock.

The completion of the 241-mile-long toll road across the State of Ohio marked two firsts in superhighway construction in the United States

ROBERT L. ROUGH*

WHEN the Ohio Turnpike was opened to the public on October 1 of this year, it marked two firsts in superhighway construction in the United States: the longest stretch of superhighway ever completed at one time – 241 miles; and the first major postwar turnpike ever finished entirely on schedule and with money to spare.

Fifteen years ago, the three principal superhighways available to the public were Connecticut's Merritt Parkway, New York's Westchester Parkway, and the Pennsylvania Turnpike. Their approximate cost totaled $108 million. By early 1955, the total mileage of our toll road systems had climbed to about 3,000 miles, representing a total investment of more than $4 billion. Schedules for further financing and construction during 1955-56 will add another 800 miles to this network.

Recognizing a need for a superhighway within the state, the Ohio State Legislature enacted a law in 1949 creating a State Turnpike Commission. The commission was empowered to construct toll roads with private capital and to issue bonds to finance the construction of the roads and to pay the costs of the commission's operations. The bonds are payable solely from revenues derived from the tolls to be charged for the use of the highways. After all bonds and debts are paid, the toll roads become part of the state highway system. The original bond issue for the Ohio Turnpike project was $326 million, which included all contingencies.

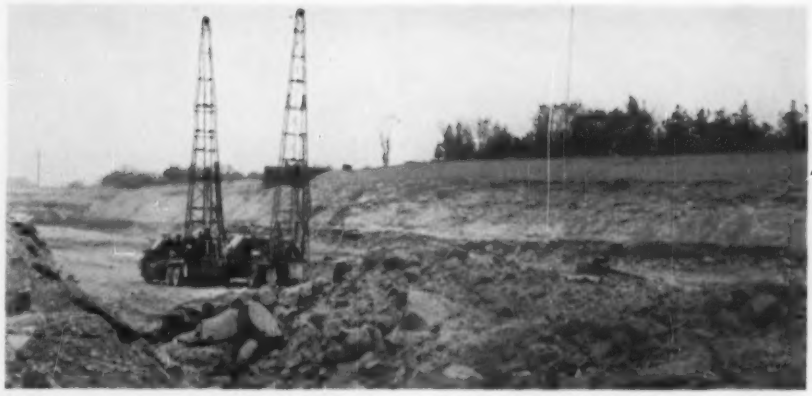
A 241-Mile Superhighway

In July of 1952, engineers on the staff of the Ohio Turnpike Commission and consulting engineers estimated that a 241-mile-long superhighway could be constructed across the state in less than 40 months. Their forecast was realized when the turnpike was opened within the time limit and at a total cost of $322,599,500.

Upon completion of the preliminary engineering work, it was decided to have the new superhighway originate at the western terminus of the Pennsylvania Turnpike near Petersburg, Ohio, and to continue it westward to

*Hercules Powder Company
Hazleton, Pennsylvania

a junction with Route 20 at the Indiana border. Eastern Ohio consists of rolling fields interspersed with swamplands and timberland. The underlying strata of the turnpike right-of-way are shale and sandstone, with the greatest concentration of sandstone extending from Windham, Ohio, westward to Berlin Heights. Within this area, eight rock cuts totaling approximately 5,390,000 cu. yd. had to be drilled and blasted. Descriptions of cutting through the rock on Sections C-14 and C-11 are presented in this article.



EXCELLENT ROCK BREAKAGE: The use of short-period delay caps to detonate the explosives in primary blasts contributed materially to consistently excellent rock breakage and a minimum of vibration.

EASY SHOVEL DIGGING: Skillful use of modern explosives and blasting techniques provided easy digging for the shovel crew on a 7-cu. yd. Marion in loading blasted material into 20-cu. yd. Mack end-dump trucks.

Section C-14

The through-cut on Section C-14, the largest on the entire project, was 300 ft. wide at the top, 150 ft. wide at the bottom, 80 ft. deep, and 3,300 ft. long. The rock consisted of 1,200,000 cu. yd. of medium standstone underlying 350,000 cu. yd. of soil. The prime contractor on this section was Western Contracting Company, Sioux City, Iowa.

Using 15-cu. yd. Euclid scrapers, Euclid and Sierra loaders, Caterpillar D8 dozers and patrols, and an 8½-cu. yd. Marion dragline, the loose top material was removed and hauled by the contractor's crews in Euclid 25-cu. yd. bottom-dump trucks to the 100-ft. fill on the west end of the section. When rock was encountered, two Failing rotary-type drills, equipped with 5⅝-in. Hughes rock bits, drilled the first 20-ft. lift. To facilitate the movement of the large haulage equipment, a face parallel to the center line was decided upon, which afforded ideal operating conditions for the workmen.

Vertical holes for blasting were drilled 20 ft. deep, spaced on an 18 by 18-ft. staggered pattern, with drilling speed averaging 2 ft. a minute. Because of the proximity to the blast area of a gas line, homes, and other structures, it was necessary to use a low explosives factor so as to minimize vibrations from blasts. At first, an ammonium nitrate powder was used. Later, when a water condition developed, a change was made to gelatin extra and semigelatin dynamites.

Short-Period Delay Caps

Each blast hole was loaded on a ratio of approximately 0.60 lb. of dynamite per 1 cu. yd. of material in place. Short-period delay electric blasting caps from 0 to 6th periods of delay inclusive were used as primers to reduce vibration and to minimize backbreak and endbreak. They also proved to be particularly effective in helping to maintain a uniform bank slope. All of the loaded charges were stemmed with approximately 10 ft. of drill cuttings. After loading 10 to 30 holes, the leg wires of the short-period delay caps were connected in series parallel, and the blast was fired with a 50-cap blasting machine. Fragmentation was consistently satisfactory and vibration was negligible. A 7-cu. yd. Marion shovel was used to load out the blasted rock into Euclid 25-cu. yd. bottom-dump and Mack 20-cu. yd. end-dump trucks.

To prevent rock falls and erosion and to provide adequate drainage, a unique method of bench shooting the slope was used. The top bench was carried on a two to one slope, the second on a one to one, and the third was one-quarter to one. The slope area was drilled in alternating inclined benches, with each bench providing drainage from one to the other. This method of rock removal required careful planning and blasting skill.

In establishing subsequent benches, Western crews used two Ingersoll-Rand wagon drills powered by an Ingersoll-Rand Gyro-Flo 600 compressor to drill rows of holes with an average depth of 8 ft. spaced on 5-ft. centers. Each hole was loaded with a charge of 40 per cent gelatin extra to within 4 ft. of the collar. Short-period delay caps were used to detonate the charges in the rows in sequence. After an area was loaded, the cap leg wires were connected in series parallel and fired with a 50-cap blasting machine. A 22-B backhoe shovel with a ¾-cu. yd. bucket trimmed the benches with comparative ease.

ROCK-CUT—SECTION C-11: The removal of a sandstone formation 32 ft. deep on Section C-11 was expedited by blasting 6-in.-diameter holes loaded with Hercomite-B primed with short-period delay electric blasting caps.

Blasting the through-cut on Section C-14 required 600,000 lb. of dynamite and 6,000 short-period delay electric blasting caps.

Section C-11

The contracting firm of R. B. Potashnick, Cape Girardeau, Missouri, took care of the removal of the 32-ft. through-cut on Section C-11. On this cut, 207,000 cu. yd. of a seamy formation of sandstone had to be drilled and blasted. Primarily a dirt-moving organization, the contractor was concerned chiefly with controlled blasting in order to obtain the fragmentation necessary for the efficient operation of its excavating equipment.

At first, the spacings of drill holes were on a 14 by 14-ft. pattern. To increase yardage and to reduce wear and tear on equipment, this pattern was changed to 12-ft. spacings and a 10-ft. burden, with the holes staggered. Using a McCarthy 6-in. auger drill equipped with tungsten carbide inserts, the holes were drilled to a depth of 16 ft. Each hole was loaded with 4½-in. by 16⅔-lb. cartridges of Hercomite®-B packed in 23G containers. The explosives loading ratio was 0.71 lb. of dynamite per 1 cu. yd. of material in place.

The charges were primed with short-period delay electric blasting caps from 0 to 6th periods of delay inclusive and stemmed with 4½ ft. of sand. The caps were connected in series parallel and blasts were fired with a 50-cap blasting machine.

The methods of drilling and blasting employed on this through-cut held vibration and backbreak to a minimum, considerably increased yardage of broken material, and effected savings in the wear and tear on equipment. These factors offset the slight additional costs of drilling and blasting brought about by the change in the drill-hole pattern.

The excavating equipment consisted of one 80-D Northwest 2½-cu. yd. straight shovel and five 14-cu. yd. bottom-dump Euclids. Consumption of explosives was 152,300 lb. of dynamite and 2,479 short-period delay electric blasting caps.

Safety

The safety of the motorists who will travel the 241-mile stretch was uppermost in the minds of the Ohio Turnpike Commission. The finished superhighway consists of two 24-ft. concrete lanes separated by a medial landscaped strip. Nowhere on the turnpike will opposing traffic be less than 56 ft. apart. A depression in the center of the medial divider makes it difficult for a vehicle out of control to cross over and face on-coming traffic. Also, maintenance crews will be able to push snow into the depression and thereby minimize the possibility of ice on the turnpike during the winter months.

All bridges have been built as separate twin structures. Overpasses span four major rivers, 38 streams, 41 railroad crossings, and 282 other roadways. Besides the regular traffic lanes, there are 10-ft.-wide asphalt-paved shoulders on the right-hand lanes and 8-ft.-wide shoulders on the left-hand lanes. Upgrades are held at a maximum of 2 per cent and the steepest downgrade is 4 per cent.

A Paying Proposition

Photoelectric eyes and electronic machines automatically figure the toll charge for each customer. The cost for a passenger car to travel the entire 241 miles is $3. Commercial vehicles pay according to total weight, with 40 tons the maximum permissible weight. The cost for a 40-ton truck to travel the entire route is $30. During the first year of operation, vehicular traffic is expected to reach 42,000 a day, with an annual yield of $19.2 million in tolls. By 1965, estimates indicate that 67,000 vehicles will use the turnpike each day, with toll charges amounting to a total of $32 million a year.

DOWN TO GRADE: This is what the through-cut on Section C-11 looked like after power shovels had excavated blasted sandstone down to grade. The stakes are placed on the center line of the medial strip.

Symposium On Rock Mechanics

A news release from the Colorado School of Mines, a college of mineral engineering at Golden, Colorado, advises that its Mining Department is sponsoring a symposium on rock mechanics at Golden, April 23 through 25, 1956. Every effort is being made to instigate a conference in which stimulating new concepts will be born.

The sponsors feel that the entire field of rock failure and its control is now amenable to a concerted, intensive attack – that the theoretical approach may soon advance from the laboratory into the field. They see a broad correlation in the problems of rock penetration and fragmentation (drilling, blasting, and other techniques), design and support of underground openings, and caving methods of mining.

C. W. Livingston, former head of the Mining Department at the college and now a senior consultant to the Department of the Army, will keynote the symposium, bringing into play his keen perception of the relation of fundamentals of rock failure under both static and dynamic loading. The aim of the sponsors in securing the foremost authorities in the field will be to present the stimulating, the challenging, and even the controversial – the why and the how – and to avoid the descriptive – the what.

Naturally, the school's instructors in the field of mining engineering are most vitally concerned with the problems of rock mechanics. But they see, also, important applications for the civil engineer, geophysicist, structural geologist, and military engineer. They definitely will strive to encourage participation of each in the symposium.

Advance registration is invited; the fee is $5.00. Address communications to L. J. Parkinson, Head, Mining Department, Colorado School of Mines, Golden, Colorado.

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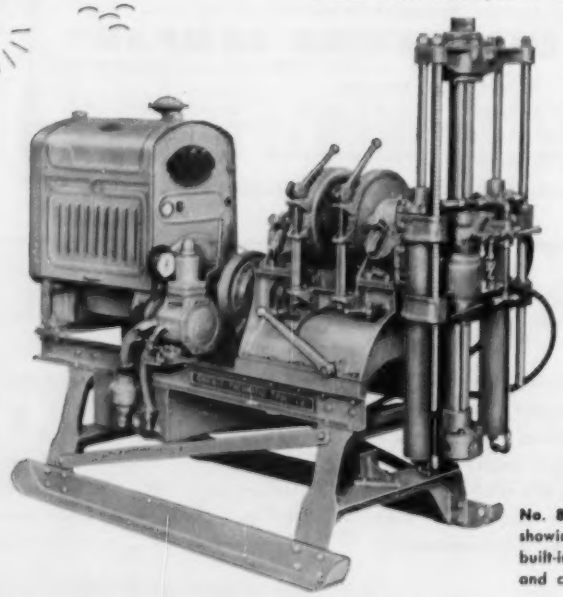

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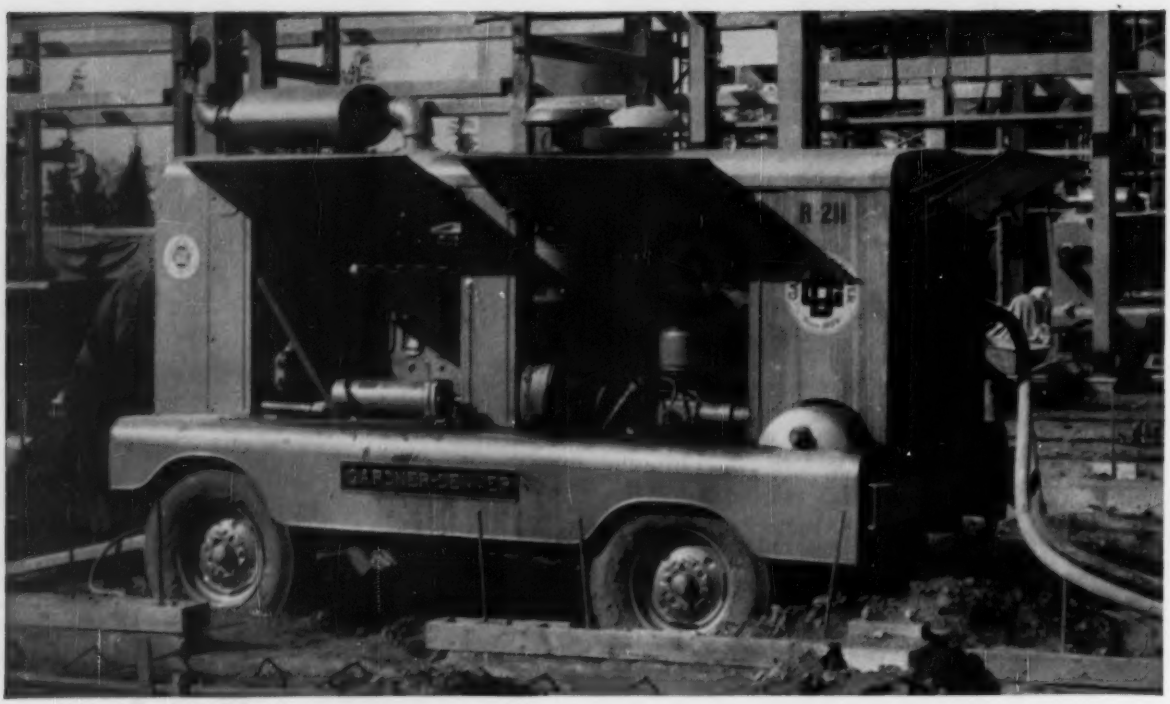

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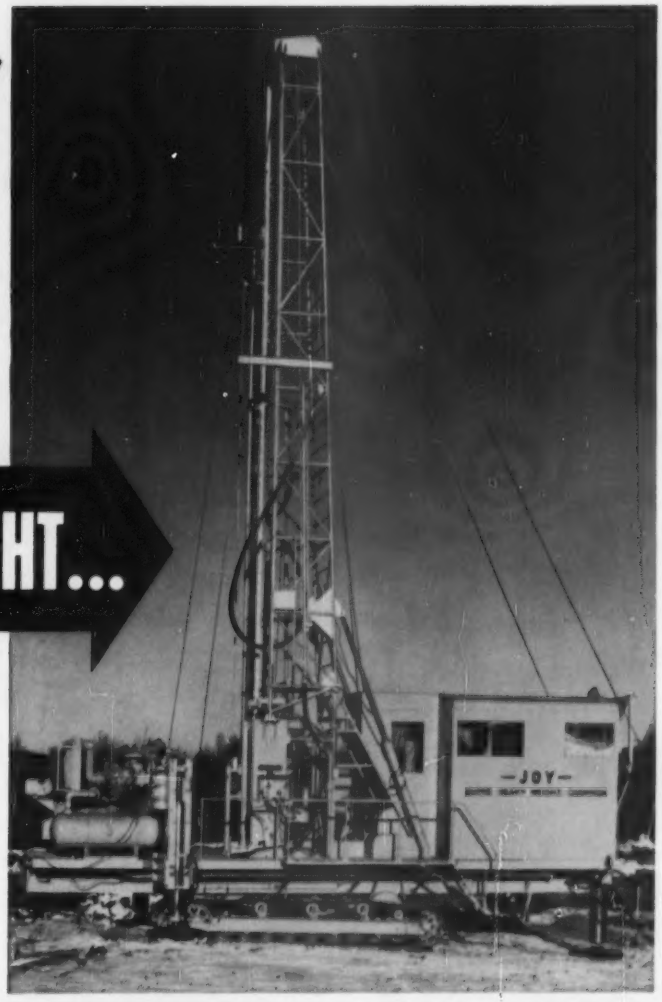

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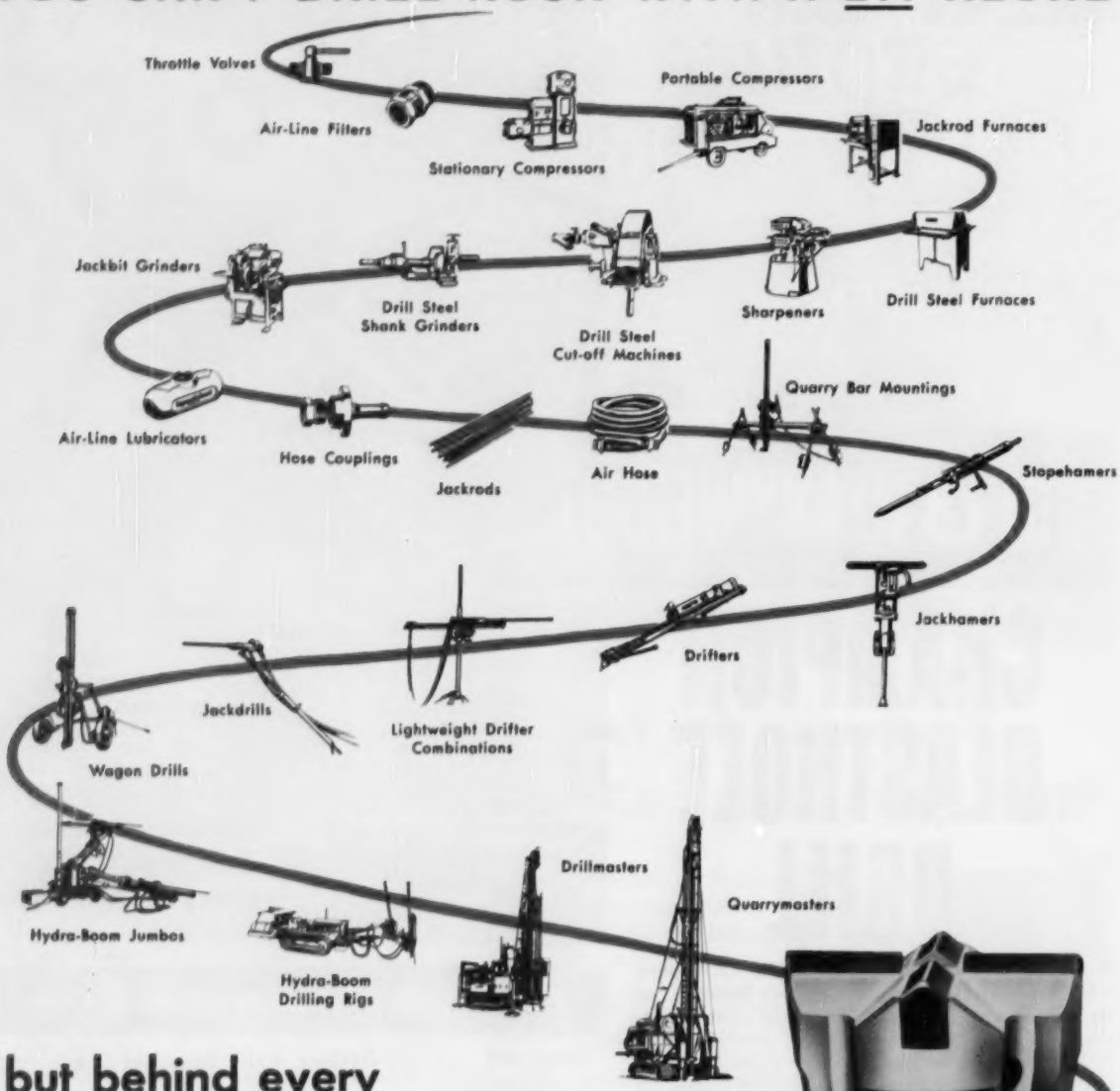

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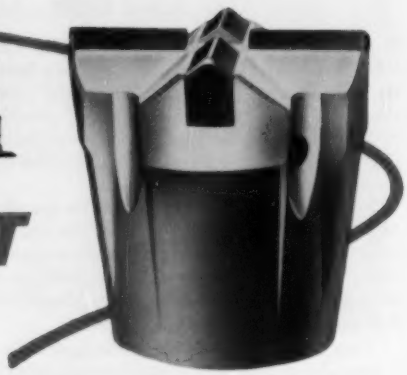

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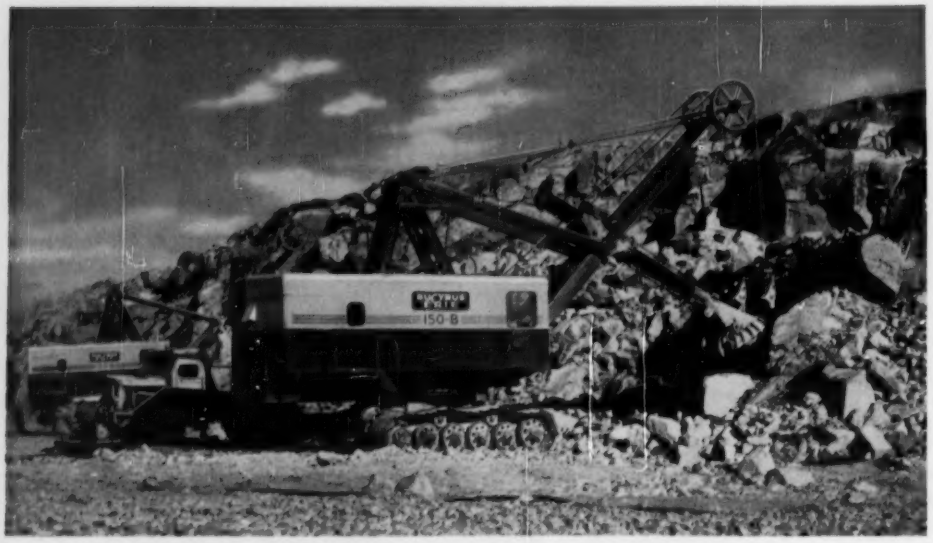

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